CHAPTER 4: OFFSITE CONSEQUENCE ANALYSIS

RMP OFFSITE CONSEQUENCE ANALYSIS GUIDANCE

This chapter is intended for people who plan to do their own air dispersion modeling. EPA has prepared a separate document, *RMP Offsite Consequence Analysis Guidance,* which provides simple methods and reference tables for determining distance to an endpoint for worst-case and alternative release scenarios. In conjunction with the National Oceanographic and Atmospheric Administration (NOAA), EPA has developed a software program, RMP*Comp™, that performs calculations described in the *RMP Offsite Consequence Analysis Guidance.* This software is available for free from the NOAA Internet website at http://www.noaa.gov. In addition, EPA is preparing industry-guidance for several industries covered by part 68. In these documents, EPA provides chemical-specific modeling for the covered industries. **All the information provided in this chapter is also included in EPA's *RMP Offsite Consequence Analysis Guidance* and the industry-specific guidance documents available from EPA.** If you intend to use those guidances to carry out your offsite consequence analysis, you may skip this chapter. If you plan to do your own modeling, this chapter will provide you with the information you need to comply with the rule requirements; it does not provide methodologies.

4.1 INTRODUCTION

The offsite consequence analysis consists of two elements:

- A **worst-case release scenario** analysis applicable to all covered processes, regardless of program level, as follows:
  - To determine whether a process is eligible for Program 1, you must evaluate the worst-case scenarios for each toxic and flammable substance held above the threshold in the process. The process is eligible for Program 1 if there are no public receptors within the distance to an endpoint for all of the worst-case scenarios analyzed for the process (and the other Program 1 criteria are met — see Chapter 2). For every Program 1 process, you must report on the worst-case scenario with the greatest distance to an endpoint.
  - If your site has Program 2 or Program 3 processes (processes that are not eligible for Program 1 — see Chapter 2), you must analyze and report on one worst-case analysis representing all toxic regulated substances present above the threshold quantity and one worst-case analysis representing all flammable regulated substances present above the threshold quantity.
  - You may need to submit an additional worst-case analysis if a worst-case release from elsewhere at the source would potentially affect public receptors different from those affected by the initial worst-case scenario(s).

- An **alternative release scenario** analysis, applicable to all Program 2 and Program 3 processes, as follows:

  - Alternative release scenarios should be those that may result in concentrations, overpressures, or radiant heat levels that reach the endpoints specified for these effects beyond the fenceline of your facility.

  - You must present information on one alternative release scenario analysis for each regulated toxic substance held above the threshold quantity, including the substance considered in the worst-case analysis.

  - You must present information on one alternative release scenario analysis to represent all flammable substances held above the threshold quantity.

If the distance to the endpoint for your worst-case release just reaches your fenceline, you may not have an alternative release scenario with a distance to an endpoint that goes beyond the fenceline. However, you still must report an alternative release scenario. You may want to explain in the RMP Executive Summary why the distance does not extend beyond the fenceline.

HOW SHOULD I CONDUCT THE ANALYSIS?

You may use EPA's *RMP Offsite Consequence Analysis Guidance* to carry out your consequence analysis. Results obtained using the methods in EPA's Guidance are expected to be conservative. Conservative assumptions have been introduced to compensate for high levels of uncertainty. EPA's guidance is optional, and you are free to use other air dispersion models, fire or explosion models, or computation methods provided that:

- They are publicly or commercially available or are proprietary models that you are willing to share with the implementing agency;

- They are recognized by industry as applicable to current practices;

- They are appropriate for the chemicals and conditions being modeled;

- You use the applicable definitions of worst-case scenarios; and

- You use the applicable parameters specified in the rule.

EXHIBIT 4-1
CONSIDERATIONS FOR CHOOSING A MODELING METHOD

Approach	Examples	Advantages	Disadvantages
Simple guidance	EPA's *Offsite Consequence Analysis Guidance*	✦ Free ✦ No computer requirements ✦ Simple to use ✦ Provides all data needed ✦ Provides tables of distances ✦ Ensures compliance with rule	✦ Conservative results ✦ Few site-specific factors considered ✦ Little flexibility in scenario development
Simple computer models	EPA models, such as RMP*Comp™	✦ No/low cost ✦ May be simple to use ✦ Can consider some site-specific factors	✦ Some may not be simple to use ✦ Likely to give conservative results ✦ May not accept all of EPA's required assumptions ✦ May not include chemical-specific data ✦ May not address all consequences
Complex computer models	Commercially available models	✦ May address a variety of scenarios ✦ May consider many site-specific factors	✦ May be costly ✦ May require high level of expertise
Calculation methods	"Yellow Book" (Netherlands TNO)	✦ Low cost ✦ No computer requirements	✦ May require expertise to apply methods ✦ May require development of a variety of data

Complex models that can account for many site-specific factors may give less conservative estimates of offsite consequences than the simplified methods in EPA's guidance, particularly for alternative scenarios, for which EPA has not specified many assumptions. However, complex models may be expensive and require considerable expertise to use; EPA's optional guidance is designed to be simple and straightforward. You will need to consider the tradeoff in deciding how to carry out your required consequence analyses. Exhibit 4-1 provides additional suggestions on making this decision.

Whether you use EPA's guidance or another modeling method, you should bear in mind that the results you obtain from modeling your worst-case or alternative scenarios should not be considered to predict the likely results of an accidental release. The worst-case assumptions are very conservative, and, regardless of the model used, you can expect very conservative results. Results from modeling alternative scenarios will be less conservative; however, you still must use conservative endpoints.

In addition, results of an actual release will depend on many site-specific conditions (e.g., wind speed and other weather conditions) and factors related to the release (e.g., when and how the release occurs, how long it takes to stop it). You should make reasonable assumptions regarding such factors in developing your alternative scenarios, but the circumstances surrounding an actual release may be different. Different models likely will provide different results, even with the same assumptions, and most models have not been verified with experimental data; therefore, results of even sophisticated modeling have a high degree of uncertainty and should be viewed as providing a basis for discussion, rather than predictions. Modeling results should be considered particularly uncertain over long distances (i.e., 10 kilometers or more).

Exhibit 4-2 provides suggestions for assistance on modeling.

4.2 WORST-CASE RELEASE SCENARIOS

EPA has defined a worst-case release as the release of the largest quantity of a regulated substance that results in the greatest distance from the point of release to a specified endpoint (§68.3). You must estimate the distance as follows:

◆ Part 68, Appendix A lists the toxic endpoint you must use for each regulated toxic substance. For the worst-case analysis for toxic substances, you are required to estimate the air dispersion distance to the endpoint, using certain conservative assumptions concerning quantity released and release conditions.

◆ A vapor cloud explosion is specified as the worst-case scenario for flammable substances. For the worst-case analysis for flammable substances, you need to estimate the distance to an overpressure endpoint of 1 pound per square inch (psi) resulting from a vapor cloud explosion of a cloud containing the largest quantity of the regulated flammable substance from a vessel or process pipe line failure.

This section describes the assumptions you must make and what you need to do to meet the requirements for worst-case scenario analysis under the rule. Exhibit 4-3 summarizes the required parameters for the worst-case analysis.

WORST-CASE RELEASES OF TOXIC SUBSTANCES

For the worst-case release analysis for toxic substances, you need to use the assumptions discussed below, the properties of the substance, and an appropriate air dispersion model or EPA's optional guidance to estimate the distance from the release point to the point at which the concentration of the substance in air is equal to the toxic endpoint specified in the rule. Because the assumptions required for the worst-case analysis are very conservative, the results likely will be very conservative. The endpoints specified for the regulated toxic substances are intended to be protective of the general public. These endpoints are concentrations below which it is believed nearly all individuals could be exposed for one-half to one hour without any serious health effects. In addition, the worst-case analysis is carried out using very

EXHIBIT 4-2
POSSIBLE SOURCES OF ASSISTANCE ON MODELING

✦ You may be able to obtain modeling help from the implementing agency in your area; for example, implementing agencies in California are preparing to provide assistance to regulated sources.

✦ If you use certain models, users' groups may be a source of assistance; for example, there is an ALOHA model users' group.

✦ If you use a commercial model, you probably can request assistance from the model developer or distributor.

✦ Publications of the Center for Process Safety of the American Institute of Chemical Engineers (AIChE) may provide useful information on modeling; examples of such publications include:

- *Guidelines for Evaluating the Characteristics of Vapor Cloud Explosions, Flash Fires, and BLEVEs* (1994), and
- *Guidelines for Use of Vapor Cloud Dispersion Models* (1987).

✦ EPA publications also may provide useful modeling information; examples include:

- *Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants*, EPA-450/4-88-009 (September 1988), and
- *Guidance on the Application of Refined Dispersion Models for Hazardous/Toxic Air Release*, EPA-454/R-93-002 (May 1993).
- EPA guidance is available at http://www.epa.gov/scram001//

conservative assumptions about weather and release conditions. The distance to the endpoint estimated under worst-case conditions should not be considered a zone in which the public would likely be in danger; instead, it is intended to provide an estimate of the maximum possible area that might be affected in the unlikely event of catastrophic conditions. Distances greater than about 10 kilometers are particularly uncertain. EPA intends the estimated distances to provide a basis for a discussion among the regulated community, emergency responders, and the public, rather than a basis for any specific actions.

MODELING ASSUMPTIONS

Quantity. EPA has defined (§68.3) a worst-case release as the release of the largest quantity of a regulated substance from a vessel or process line failure that results in the greatest distance to a specified endpoint. For substances in vessels, you must assume release of the largest amount in a single vessel; for substances in pipes, you must assume release of the largest amount in a pipe.

EXHIBIT 4-3
REQUIRED PARAMETERS FOR MODELING WORST-CASE SCENARIOS

Endpoints
- For toxic substances, use the endpoint specified in part 68, Appendix A.
- For flammable substances, use the endpoint of an overpressure of 1 pound per square inch (psi) for vapor cloud explosions.

Wind speed/stability
- Use wind speed of 1.5 meters per second and F stability class unless you can demonstrate that local meteorological data applicable to the site show a higher minimum wind speed or less stable atmosphere at all times during the previous three years. If you can demonstrate a higher minimum wind speed or less stable atmosphere over three years, these minimums may be used.

Ambient temperature/humidity
- For toxic substances, use the highest daily maximum temperature during the past three years and average humidity for the site.

Height of release
- For toxic substances, assume a ground level release.

Topography
- Use urban or rural topography, as appropriate.

Dense or neutrally buoyant gases
- Tables or models used for dispersion of regulated toxic substances must appropriately account for gas density.

Temperature of released substance
- For liquids (other than gases liquefied by refrigeration), use the highest daily maximum temperature, based on data for the previous three years, or at process temperature, whichever is higher.
- Assume gases liquefied by refrigeration at atmospheric pressure are released at their boiling points.

The largest quantity should be determined taking into account administrative controls. Administrative controls are written procedures that limit the quantity of a substance that can be stored or processed in a vessel or pipe at any one time, or, alternatively, occasionally allow a vessel or pipe to store larger than usual quantities (e.g., during turnaround). You do not need to consider the possible causes of the worst-case release or the probability that such a release might occur; the release is simply assumed to take place.

Release Height. All releases are assumed to take place at ground level for the worst-case analysis. This is a conservative assumption in most cases. Even if you think a ground-level release is unlikely at your site, you must use this assumption for the worst-case analysis.

Wind Speed and Atmospheric Stability. Meteorological conditions for the worst-case scenario are defined in the rule as atmospheric stability class F (stable atmosphere) and wind speed of 1.5 meters per second (3.4 miles per hour). If, however, you can demonstrate that the minimum wind speed at your site (measured at 10 meters) has been higher than 1.5 meters per second, or that the maximum atmosphere stability has always been less stable than class F, you may use the minimum wind speed and most stable atmospheric conditions at your site for the worst-case analysis. To demonstrate higher minimum wind speeds or less stable atmospheric conditions, you will need to document local meteorological data from the previous three years that are applicable to your site. If you do not keep weather data for your site (most sources do not), you may call another nearby source, such as an airport, or a compiler, such as the National Weather Service, to determine wind speeds for your area. Exhibit 3-1 in Chapter 3 describes atmospheric stability classes in relation to wind speed and cloud cover. Your airport or other source will be able to give you information on cloud cover. A small difference in wind speed probably will not lead to a significant decrease in the distance to the endpoint.

Temperature and Humidity. For the worst-case release of a regulated toxic substance, you must assume the highest daily maximum temperature that occurred in the previous three years (the highest temperature reached in the last three years) and the average humidity for the site. If you have not kept information on temperature and humidity at your site, you may obtain it from a local meteorological station. EPA's *RMP Offsite Consequence Analysis Guidance* assumes a temperature of 25°C (77°F) and 50 percent humidity. If you use the EPA's guidance for your offsite consequence analysis, you may use these assumptions even if the actual highest temperature at your site is higher or lower. If the temperature at your site is significantly lower, EPA's guidance may give overly conservative results, particularly for toxic liquids. Small differences in temperature and humidity are unlikely to have a major effect on results, however.

Topography. Two choices are provided for topography for the worst-case scenario. If your site is located in an area with few buildings or other obstructions, you should assume open (rural) conditions. If your site is in an urban location, or is in an area with many obstructions, you should assume urban conditions.

Gas or Vapor Density. For the worst-case analysis, you must use a model appropriate for the density of the released gas or vapor. Generally, for a substance that is lighter than air or has a density similar to that of air, you would use a model for neutrally buoyant vapors. The initial vapor density of a substance with respect to air can be estimated from its molecular weight, assuming air has a "molecular weight" of approximately 29. For a substance that is heavier than air (molecular weight greater than 29), you generally would use a dense gas model. There are cases where a dense gas model may be appropriate for a substance with molecular weight of 29 or less (e.g., release of a compressed gas as a cold vapor) or where a neutrally buoyant plume model may be appropriate for a substance with a higher molecular weight (e.g., release by slow evaporation, with considerable mixing with air). In addition, dense gases and vapors will become neutrally buoyant through mixing with air as they move downwind. If you can account for such conditions in modeling, you may do so.

ESTIMATING RELEASE RATES

Toxic Gases. Toxic gases include all regulated toxic substances that are gases at ambient temperature (temperature 25º C, 77º F). For the consequence analysis, the total quantity in the single largest vessel or process line is assumed to be released as a gas over a period of 10 minutes, except in the case of gases liquefied by refrigeration under atmospheric pressure. The release rate (per minute) for a gas (not liquefied by refrigeration) is the total quantity released divided by 10. Passive mitigation measures (e.g., enclosure) may be taken into account in the analysis of the worst-case scenario. A 10-minute release must be assumed for gases regardless of the model you use.

Gases liquefied by refrigeration alone (not under pressure) and released into diked areas may be modeled as liquids at their boiling points, if the pool formed by the released liquid would be greater than one centimeter (0.39 inches) in depth. In this case, you may assume the liquefied gas is released from a pool by evaporation at the boiling point of the gas. If the refrigerated liquefied gas is not contained by passive mitigation, or if the pool formed would have a depth of one centimeter or less, you must treat the released substance as a gas released over 10 minutes. EPA's analysis indicated that pools of gas liquefied by refrigeration with a depth of one centimeter or less would evaporate so rapidly at their boiling points that treatment as gaseous releases over 10 minutes is reasonable.

Toxic liquids. For toxic liquids, you must assume that the total quantity in a vessel is spilled, forming a pool. For toxic liquids carried in pipelines, you must assume that the largest quantity that might be released from the pipeline forms a pool. Passive mitigation systems (e.g., dikes) may be taken into account in consequence analysis. You must assume that the total quantity spilled spreads instantaneously to a depth of one centimeter (0.39 inches) in an undiked area or covers a diked area instantaneously. You estimate the release rate to air as the rate of evaporation from the pool. To estimate the evaporation rate, you need to estimate the surface area of the pool. You can take into account the surface characteristics of the area into which the liquid would be spilled; for example, some models for pool evaporation will take into account the type of soil if the spill will take place in an unpaved area. Your modeling also should consider the length of time it will take for the pool to evaporate.

You may use any appropriate model to estimate the evaporation rate of a spilled regulated substance from a pool and estimate the air dispersion distance to the specified endpoint of the regulated substance. The release rate can then be used to estimate the distance to the endpoint.

Estimating Distance to the Endpoint

You may use any appropriate model, as discussed above, to estimate the distance to the endpoint specified in part 68 Appendix A for a release of a regulated toxic substance, using the required modeling assumptions.

Worst-Case Releases of Flammable Substances

For the worst-case scenario involving a release of a regulated flammable substance (a flammable gas or volatile flammable liquid), you must assume that the total quantity of the flammable substance is released into a vapor cloud. A vapor cloud explosion is assumed to result from the release. You must estimate the distance to an endpoint to an overpressure level of 1 pound per square inch (psi) from the explosion of the vapor cloud.

As in the case of the worst-case release analysis for toxic substances, the worst-case distance to the endpoint for flammable substances is based on a number of very conservative assumptions. Release of the total quantity of a flammable substance in a vessel or pipe into a vapor cloud generally would be highly unlikely. Vapor cloud explosions are also unlikely events; in an actual release, the flammable gas or vapor released to air might disperse without ignition, or it might burn instead of exploding, with more limited consequences. The endpoint of 1 psi is intended to be conservative and protective; it does not define a level at which severe injuries or death would be commonly expected. An overpressure of 1 psi is unlikely to have serious direct effects on people; this overpressure may cause property damage such as partial demolition of houses, which can result in injuries to people, and shattering of glass windows, which may cause skin laceration from flying glass.

To carry out the worst-case consequence analysis for flammable substances, you may use a TNT-equivalent model (i.e., a model that estimates the explosive effects of a flammable substance by comparison with the effects of an equivalent quantity of the high explosive trinitrotoluene (TNT), based on the available combustion energy in the vapor cloud). Such models allow you to estimate the distance to a specific overpressure level, based on empirical data from TNT explosions. If you use a TNT-equivalent model, you must assume that 10 percent of the flammable vapor in the cloud participates in the explosion (i.e., you assume a 10 percent yield factor for the explosion). You do not have to use a TNT-equivalent model; other models are available that take into account more site-specific factors (e.g., degree of confinement of the vapor cloud). Generally, however, a TNT-equivalent model is the simplest to use.

NUMBER OF SCENARIOS

The number of worst-case scenarios you must analyze depends on several factors as discussed below. You only need to consider the hazard (toxicity or flammability) for which a substance is regulated (i.e., even if a regulated toxic substance is also flammable, you only need to consider toxicity in your analysis; even if a regulated flammable substance is also toxic, you only need to consider flammability).

PROGRAM 1 PROCESSES

To demonstrate that a process is eligible for Program 1 (see Chapter 2), you conduct a worst-case release analysis of it and that analysis must show that the distance to the specified endpoint for every regulated substance in the process is smaller than the distance to any public receptor. If you have several processes that may qualify for Program 1, you will have to carry out a worst-case analysis for each process to determine which qualify. You will need to report in the RMP the worst-case results for those processes you determine to be eligible for Program 1.

If the distance to the endpoint in the worst-case analysis is equal to or greater than the distance to any public receptor, the process would be in Program 2 or Program 3 (discussed below). When you consider possible eligibility of your processes for

Program 1, you may want to look particularly at processes containing flammable substances, which are likely to give shorter worst-case distances than toxic substances.

PROGRAM 2 AND 3 PROCESSES

For all your Program 2 and 3 processes together (see Chapter 2), you must carry out and report in the RMP one worst-case analysis for the regulated toxic substances and one worst-case analysis for the regulated flammable substances held above their threshold quantities. The basic purpose of the worst-case analysis is to identify all of the public receptors that could be affected by a worst-case release. The release that results in the greatest distance to an endpoint would affect the greatest number of public receptors so only that release (and not others affecting a subset of the those receptors) needs to be reported. The reported scenario for toxic substances must be the scenario estimated to result in the greatest distance to a specified toxic endpoint; for flammable substances, it must be the scenario estimated to lead to the greatest distance to 1 psi overpressure for a vapor cloud explosion. Additional worst-case analyses must be reported for toxic or flammable substances if a worst-case release from a different location at the facility potentially would affect different public receptors from those affected by the scenario giving the greatest distance.

IDENTIFYING THE "WORST" WORST-CASE SCENARIO

Toxics. To determine the scenario that gives the greatest distance to an endpoint for processes containing toxic substances, you may have to analyze more than one scenario, because the distances depend on more than simply the quantity in a process. For toxic liquids, for example, distances depend on the magnitude of the toxic endpoint, the molecular weight and volatility of the substance, and the temperature of the substance in the process, as well as quantity. A smaller quantity of a substance at an elevated temperature may give a greater distance to the endpoint than a larger quantity of the same substance at ambient temperature. In some cases, it may be difficult to predict which substance and process will give the greatest worst-case distance. You also may need to carry out analyses of worst-case scenarios for locations at significant distances from each other to determine whether different public receptors might be affected by releases.

Flammables. For flammable substances, the greatest quantity in a process is likely to give the greatest distance to the endpoint, but there may be variations, depending on heat of combustion and distance to the fenceline. You may have to carry out several analyses to identify the scenario that gives the greatest distance to the endpoint. As in the case of toxic substances, you also may need to carry out analyses for locations far apart from each other to determine whether different public receptors might be affected.

For both toxic and flammable substances, the worst-case distances should be considered only approximations.

QS & AS
WORST-CASE AND MITIGATION

Q. At my facility, if the worst-case release scenarios for regulated toxic substances and the worst-case scenario for regulated flammable substances involve the same process, must I analyze both?

A. Yes. If the worst-case release scenarios for regulated toxic substances and regulated flammable substances in Program 2 and 3 processes are associated with the same process, the two worst-case release scenarios must be analyzed separately.

Q. What measures qualify as "passive mitigation"?

A. Passive mitigation is defined in § 68.3 as "equipment, devices, or technologies that function without human, mechanical, or other energy input." Passive mitigation systems include building enclosures, dikes, and containment walls. Measures such as fire sprinkler systems, water curtains, valves, scrubbers, or flares would not be considered passive mitigation because they require human, mechanical, or energy input to function.

Q. When analyzing the worst-case scenario for regulated toxic substances, must I anticipate a specific cause (e.g., fire, explosion, etc.) of the scenario?

A. No. The worst-case analysis for a release of regulated toxic substances must conform to specific assumptions as identified in § 68.25(c) and (d). Anticipated causes of the release will not affect the analysis, and are not required. A specific cause may be considered in analyzing the alternative release scenarios although it is not a requirement.

Q. Would all of the regulated substances stored in a salt dome be assumed to be released in the worst-case scenario?

A. The worst case scenario for salt domes would be examined in a manner similar to that for underground storage tanks. Reservoirs or vessels sufficiently buried underground are passively mitigated or prevented from failing catastrophically. You should evaluate the failure of piping connected to underground storage for the worst-case and alternative scenarios.

Q. Are valves in piping considered administrative controls?

A. No, administrative controls are written procedures that limit the quantity stored or flowing through the pipes. Valves are considered active mitigation systems.

4.3 ALTERNATIVE RELEASE SCENARIOS

There are only a few required assumptions for the alternative scenario analysis. Exhibit 4-4 summarizes the required assumptions.

EXHIBIT 4-4
REQUIRED PARAMETERS FOR MODELING ALTERNATIVE SCENARIOS

Endpoints

- For toxic substances, use the endpoints specified in part 68, Appendix A.
- For flammable substances, use as the endpoints:
  - Overpressure of 1 pound per square inch (psi) for vapor cloud explosions,
  - Radiant heat of 5 kilowatts per square meter (kW/m^2) (or equivalent dose) for fireballs or pool fires, or
  - Lower flammability limit (LFL) for vapor cloud fires.

Wind speed/stability

- Use typical meteorological conditions at your site.

Ambient temperature/humidity

- Use average temperature/humidity data gathered at your site or at a local meteorological station.

Height of release

- Release height may be determined by the release scenario.

Topography

- Use urban or rural topography, as appropriate.

Dense or neutrally buoyant gases

- Tables or models used for dispersion of regulated toxic substances must appropriately account for gas density.

Temperature of released substance

- Substances may be considered to be released at a process or ambient temperature that is appropriate for the scenario.

ACCEPTABLE ALTERNATIVE SCENARIOS

Your alternative scenario for a covered process must be one that is more likely to occur than the worst-case scenario and that reaches an endpoint offsite, unless no such scenario exists. You do not need to demonstrate greater likelihood of occurrence or carry out any analysis of probability of occurrence; you only need to use reasonable judgement and knowledge of the process. If, using a combination of reasonable assumptions, modeling of a release of a regulated substance from a process shows that the relevant endpoint is not reached offsite, you can use the modeling results to demonstrate that a scenario does not exist for the process that will give an endpoint offsite. You must report an alternative scenario, however.

Release scenarios you should consider include, but are not limited to, the following, where applicable:

- Transfer hose releases due to splits or sudden uncoupling;
- Process piping releases from failures at flanges, joints, welds, valves and valve seals, and drains or bleeds;
- Process vessel or pump releases due to cracks, seal failure, drain bleed, or plug failure;
- Vessel overfilling and spill, or overpressurization and venting through relief valves or rupture disks; and
- Shipping container mishandling and breakage or puncturing leading to a spill.

For alternative release scenarios, you may consider active mitigation systems, such as interlocks, shutdown systems, pressure relieving devices, flares, emergency isolation systems, and fire water and deluge systems, as well as passive mitigation systems. Mitigation systems considered must be capable of withstanding the event that triggers the release while remaining functional.

You must consider your five-year accident history and failure scenarios identified in your hazard review or process hazards analysis in selecting alternative release scenarios for regulated toxic or flammable substances (e.g., you might choose an actual event from your accident history as the basis of your scenario). You also may consider any other reasonable scenarios.

The alternative scenarios you choose to analyze should be scenarios that you consider possible at your site. Although EPA requires no explanation of your choice of scenario, you should choose a scenario that you think you can explain to emergency responders and the public as a reasonable alternative to the worst-case scenario. For example, you could pick a scenario based on an actual event, or you could choose a scenario that you worry about, because circumstances at your site might make it a possibility. If you believe that there is no reasonable scenario that could lead to offsite consequences, you may use a scenario that has no offsite impacts for your alternative analysis. You should be prepared to explain your choice of such a scenario to the public, should questions arise.

ALTERNATIVE RELEASES OF TOXIC SUBSTANCES

To estimate distances to the endpoint for alternative releases of toxic substances, you need to identify reasonable scenarios for the regulated substances in covered processes at your site and model these scenarios using appropriate models. As noted above, for alternative release scenarios, you are permitted to take credit for both passive and active mitigation systems, or a combination if both are in place. Modeling alternative releases of toxic substances is discussed below.

Although alternative scenarios are intended to be more likely than worst-case scenarios, the analysis of alternative scenarios should not be expected to provide realistic estimates of areas in which the public might be endangered in case of a release. The same conservative, protective endpoints are used for alternative release analysis as for worst-case analysis. These endpoints are intended to represent exposure levels below which most members of the public will not suffer any serious health effects. The endpoints are based on exposures for longer periods than may be likely in an actual release. In addition, modeling carried out to estimate distances to these endpoints, even when based on more realistic assumptions than used for the worst-case modeling, likely will provide results with a high degree of uncertainty. These estimated distances should not be considered a necessarily accurate prediction of the results of an actual release.

MODELING ASSUMPTIONS

Quantity. EPA has not specified any assumptions you must make concerning quantity released for an alternative release scenario. You could consider any site-specific factors in developing a reasonable estimate of quantity released (e.g., the quantity that could be released from a sheared pipe in the time it would take to shut off flow to the pipe).

Release Height. You may assume any appropriate release height for your alternative scenarios. For example, you may analyze a scenario in which a regulated substance would be released at a height well above ground level.

Wind Speed and Atmospheric Stability. You should use typical meteorological conditions at your site to model alternative scenarios. To determine typical conditions, you may need to obtain local meteorological data that are applicable to your site. If you do not keep weather data for your site (most sources do not), you may call another nearby source, such as an airport, or a compiler, such as the National Weather Service, to determine wind speeds for your area. Your airport or other source will be able to give you information on cloud cover.

ESTIMATING RELEASE RATES

Toxic Gases. To estimate a release rate for toxic gases, you may make any appropriate assumptions based on conditions at your site and use any appropriate model. EPA's *RMP Offsite Consequence Analysis Guidance* provides a simple equation and chemical-specific data for estimating the release rate of a gas from a hole in a vessel or pipe based on hole size, tank pressure, and chemical properties. The size of the hole might be estimated from, for example, the hole size that would result from shearing off a valve or pipe from a vessel.

Tank or pipe damage or failure resulting in the release of a gas liquefied under pressure might be an appropriate alternative scenario at some sites. If such a release would be possible at your site, you may need to consider a model or method that will deal with this type of scenario.

You also should consider the duration of the release. EPA does not require you to assume any specific time period for the release. You could estimate the release duration based on the length of time it would take to stop the release, or you could estimate a maximum duration based on a calculated release rate and the quantity in the tank or pipes. If you estimate that a release of toxic gas would be stopped very quickly, resulting in a "puff" rather than a plume, you may want to use a model that deals with puff releases. EPA's *RMP Offsite Consequence Analysis Guidance* is not appropriate for estimating distance to an endpoint for puff releases.

You may consider both passive and active mitigation in estimating release rates. For gases, passive mitigation may include enclosed spaces. Active mitigation for gases may include an assortment of techniques including automatic shutoff valves, rapid transfer systems (emergency deinventory), and water/chemical sprays. These mitigation techniques have the effect of reducing either the release rate or the duration of the release, or both. EPA's *RMP Offsite Consequence Analysis Guidance* includes methods of accounting for mitigation. You also may use your knowledge or other methods to account for mitigation.

Toxic liquids. For alternative releases of toxic liquids, you may consider any scenario that would be reasonable for your site. For alternative release scenarios, you are permitted to take credit for both passive and active mitigation systems, or a combination if both are in place. For liquids, passive mitigation may include techniques such as dikes and trenches. Active mitigation for liquids may include an assortment of techniques including automatic shutoff valves, emergency deinventory, foam or tarp coverings, and water or chemical sprays. These mitigation techniques have the effect of reducing either the quantity released into the pool or the evaporation rate from the pool. EPA's *RMP Offsite Consequence Analysis Guidance* discusses some methods of accounting for mitigation.

ESTIMATING DISTANCE TO THE ENDPOINT

For worst-case releases, you may use any appropriate model (as discussed in 4.1) to estimate the distance to the specified endpoint for an alternative release of a regulated toxic substance. You may use site-specific conditions, including typical weather conditions, and consider any site-specific factors appropriate to your scenario. You must use the endpoints specified in part 68 Appendix A, as for the worst-case analysis.

ALTERNATIVE RELEASES OF FLAMMABLE SUBSTANCES

Alternative release scenarios for flammable substances are somewhat more complicated than for toxic substances because the consequences of a release and the endpoint of concern may vary. For the worst case, the consequence of concern is a vapor cloud explosion, with an overpressure endpoint. For alternative scenarios involving fires rather than explosions, other endpoints than overpressure (e.g., heat radiation) may need to be considered. The rule specifies endpoints for fires based on the heat radiation level that may cause second degree burns from a 40-second exposure and the lower flammability limit (LFL), which is the lowest concentration in air at which a substance will burn. Some possible scenarios involving flammable substances are discussed below.

- **Vapor cloud fires** (flash fires) may result from dispersion of a cloud of flammable vapor and ignition of the cloud following dispersion. Such a fire could flash back and could represent a severe heat radiation hazard to anyone in the area of the cloud. Vapor cloud fires may be modeled using air dispersion modeling techniques to estimate distances to a concentration equal to the LFL.

- A **pool fire**, with potential radiant heat effects, may result from a spill of a flammable liquid. The endpoint for this type of fire, as listed in the rule, is a radiant heat level of 5 kilowatts per square meter (kW/m2) for 40 seconds; a 40-second exposure to this heat level could cause second degree burns.

- A **boiling liquid, expanding vapor explosion (BLEVE)**, leading to a fireball that may produce intense heat, may occur if a vessel containing flammable material ruptures explosively as a result of exposure to fire. Heat radiation from the fireball is the primary hazard; vessel fragments and overpressure from the explosion also can result. BLEVEs are generally considered unlikely events; however, if you think a BLEVE is possible at your site, you should estimate the distance at which radiant heat effects might lead to second degree burns. However, if you think a BLEVE is possible at your site, you should estimate the distance at which radiant heat effects might cause second degree burns, since that is the effect of concern underlying the rule's endpoint for fires. The point of offsite consequence analyses is to determine how far away from the point of release effects of concern could occur, so you should estimate the distance for BLEVEs even if they do not last for 40 seconds. For short-duration BLEVEs, you would need to estimate the radiant heat level at which exposure for the duration of the BLEVE would cause second degree burns. You then would need to estimate the distance to that heat level. You then would need to estimate the distance to that heat level. You also may want to consider models or calculation methods to estimate effects of vessel fragmentation, although you are not required to analyze such effects.

- For a **vapor cloud explosion** to occur, rapid release of a large quantity of flammable material, turbulent conditions (caused by a turbulent release or congested conditions in the area of the release, or both), and other factors are generally necessary. Vapor cloud explosions generally are considered unlikely events; however, if conditions at your site are conducive to vapor cloud explosions, you may want to consider a vapor cloud explosion as an alternative scenario. The 1 psi overpressure endpoint still applies to a vapor cloud explosion for purposes of analyzing an alternative scenario, but you could use less conservative assumptions than for the worst-case analysis, including any reasonable estimate of the quantity in the cloud and the yield factor. A vapor cloud deflagration, involving lower flame speeds than a detonation and resulting in less damaging blast effects, is more likely than a detonation. You may assume a vapor cloud deflagration for the alternative scenario, if you think it is appropriate, and use the radiant heat endpoint (adjusted for duration).

- A **jet fire** may result from the puncture or rupture of a tank or pipeline containing a compressed or liquefied gas under pressure. The gas discharging from the hole can form a jet that "blows" into the air in the direction of the hole; the jet then may ignite. Jet fires could contribute to BLEVEs and fireballs if they impinge on tanks of flammable substances. A large horizontal jet fire may have the potential to pose an offsite hazard. You may want to consider a jet fire as an alternative scenario, if appropriate for your site.

Modeling Assumptions

Quantity. EPA has not specified any assumptions you must make concerning quantity released for alternative scenario analysis for flammable substances. You may consider any site-specific factors in developing a reasonable estimate of quantity released, as for toxic substances (e.g., the quantity that could be released from a ruptured pipe in the time it would take to shut off flow to the pipe).

Release Height. You may assume any appropriate release height for your alternative scenarios for flammable substances.

Wind Speed and Atmospheric Stability. Meteorological conditions may have little effect on some scenarios for flammable substances (e.g., vapor cloud explosions and BLEVEs), but may have a relatively large effect on others (e.g., a vapor cloud fire resulting from downwind dispersion of a vapor cloud and subsequent ignition). You should use typical meteorological conditions at your site to model appropriate alternative scenarios. To determine typical conditions, you may need to obtain local meteorological data that are applicable to your site, as discussed above.

Estimating Release Rates

Flammable Gases. To estimate a release rate for flammable gases, you may make any appropriate assumptions based on conditions at your site. You may consider the effects of both passive and active mitigation systems. The methods provided in EPA's *RMP Offsite Consequence Analysis Guidance* for rate of release of a gas from a hole in a vessel or pipe for toxic gases also can be used for flammable gases. Chemical-specific data are provided for flammable gases, to be used along with hole size and tank pressure to estimate release rates.

Flammable liquids. For alternative releases of flammable liquids, you may consider any scenario that would be reasonable for your site. You are permitted to take credit for both passive and active mitigation systems, or a combination if both are in place, as for toxic liquids. You could consider release of the liquid into a pool and release to air by pool evaporation, as for toxic liquids, if you consider this to be a reasonable scenario.

If evaporation of a flammable liquid from a pool is an appropriate assumption for your alternative scenario, you can use any scientifically appropriate method to estimate the evaporation rate.

Estimating Distance to the Endpoint

You may use any appropriate model to estimate the distance to the specified endpoint for alternative scenarios for regulated flammable substances. Several possible consequences of releases of flammable substances are discussed below.

Vapor cloud fire. You may use any appropriate model to estimate distances for a vapor cloud fire. The LFL endpoint, specified in the rule, would be appropriate for vapor cloud fires. You may use air dispersion modeling to estimate the maximum distance to the LFL. You may want to consider, however, whether it is likely that a flammable gas or vapor could disperse to the maximum distance to the LFL before reaching an ignition source. The actual dispersion distance before ignition might be much shorter than the maximum possible distance.

Pool fire. Any appropriate model may be used for pool fires of flammable liquids. The applicable endpoint specified in the rule is the heat radiation level of 5 kW/m^2.

BLEVE. If a fireball from a BLEVE is a potential release scenario at your site, you may use any model or calculation method to estimate the distance to a radiant heat level that can cause second degree burns (a heat "dose" equivalent to the specified radiant heat endpoint of 5 kW/m^2 for 40 seconds).

Vapor cloud explosion. If you have the potential at your site for the rapid release of a large quantity of a flammable vapor, particularly into a congested area, a vapor cloud explosion may be an appropriate alternative release scenario. For the alternative analysis, you may estimate any reasonable quantity of flammable substance in the vapor cloud. The endpoint for vapor cloud explosions is 1 psi, as for the worst case; however, a smaller yield factor may be used for the alternative scenario analysis.

NUMBER OF SCENARIOS

You are required to analyze at least one alternative release scenario for each listed toxic substance you have in a Program 2 or Program 3 process above its threshold quantity. Even if you have a substance above the threshold in several processes or locations, you need only analyze one alternative scenario for it. You also are required to analyze one alternative release scenario representing all regulated flammable substances in Program 2 or 3 processes; you do not need to analyze an alternative scenario for each flammable substance above the threshold. For example, if you have five listed substances — chlorine, ammonia, hydrogen chloride, propane, and acetylene — above the threshold in Program 2 or 3 processes, you will need to analyze one alternative scenario each for chlorine, ammonia, and hydrogen chloride (toxics) and a single alternative scenario to cover propane and acetylene (flammable substances).

No alternative scenario analysis is required for regulated substances in Program 1 processes. If the worst-case analysis shows no public receptors within the distance to the endpoint, and the process meets the other Program 1 criteria, you do not have to carry out an alternative scenario analysis.

In addition, no alternative scenario analysis is required for any process that does not contain more than a threshold quantity of a regulated substance, even if you believe such a process is a likely source of a release.

4.4 ESTIMATING OFFSITE RECEPTORS

The rule requires that you estimate in the RMP residential populations within the circle defined by the endpoint for your worst-case and alternative release scenarios (i.e., the center of the circle is the point of release and the radius is the distance to the endpoint). In addition, you must report in the RMP whether certain types of public receptors and environmental receptors are within the circles.

RESIDENTIAL POPULATIONS

To estimate residential populations, you may use the most recent Census data or any other source of data that you believe is more accurate. You are not required to update Census data or conduct any surveys to develop your estimates. Census data are available in public libraries and in the LandView system, which is available on CD-ROM (see box below). The rule requires that you estimate populations to two-significant digits. For example, if there are 1,260 people within the circle, you may report 1,300 people. If the number of people is between 10 and 100, estimate to the nearest 10. If the number of people is less than 10, provide the actual number.

Census data are presented by Census tract. If your circle covers only a portion of the tract, you should develop an estimate for that portion. The easiest way to do this is to determine the population density per square mile (total population of the Census tract divided by the number of square miles in the tract) and apply that density figure to the number of square miles within your circle. Because there is likely to be considerable variation in actual densities within a Census tract, this number will be approximate. The rule, however, does not require you to correct the number.

OTHER PUBLIC RECEPTORS

Other public receptors must be noted in the RMP (see the discussion of public receptors in Chapter 2). If there are any schools, residences, hospitals, prisons, public recreational areas or arenas, or commercial or industrial areas within the circle, you must report that. You are not required to develop a list of all public receptors; you must simply check off that one or more such areas is within the circle. Most receptors can be identified from local street maps.

ENVIRONMENTAL RECEPTORS

Environmental receptors are defined as natural areas such as national or state parks, forests, or monuments; officially designated wildlife sanctuaries, preserves, refuges, or areas; and Federal wilderness areas. Only environmental receptors that can be identified on local U.S. Geological Survey (USGS) maps (see box below) need to be considered. You are not required to locate each of these specifically. You are only required to check off in the RMP which specific types of areas are within the circle. If any part of one of these receptors is within your circle, you must note that in the RMP.

Important: The rule does not require you to assess the likelihood, type, or severity of potential impacts on either public or environmental receptors. Identifying them as within the circle simply indicates that they could be adversely affected by the release.

HOW TO OBTAIN CENSUS DATA AND LANDVIEW®

Census data can be found in publications of the Bureau of the Census, available in public libraries, including *County and City Data Book*.

LandView ®III is a desktop mapping system that includes database extracts from EPA, the Bureau of the Census, the U.S. Geological Survey, the Nuclear Regulatory Commission, the Department of Transportation, and the Federal Emergency Management Agency. These databases are presented in a geographic context on maps that show jurisdictional boundaries, detailed networks of roads, rivers, and railroads, census block group and tract polygons, schools, hospitals, churches, cemeteries, airports, dams, and other landmark features.

CD-ROM for IBM-compatible PCS
CD-TGR95-LV3-KIT $99 per disc (by region) or $549 for 11 disc set

U.S. Department of Commerce
Bureau of the Census
P.O. Box 277943
Atlanta, GA 30384-7943
Phone: 301-457-4100 (Customer Services -- orders)
Fax: (888) 249-7295 (toll-free)
Fax: (301) 457-3842 (local)
Phone: (301) 457-1128 (Geography Staff -- content)
http://www.census.gov/ftp/pub/geo/www/tiger/

Further information on LandView and other sources of Census data is available at the Bureau of the Census web site at www.census.gov.

How to Obtain USGS Maps

The production of digital cartographic data and graphic maps comprises the largest component of the USGS National Mapping Program. The USGS's most familiar product is the 1:24,000-scale Topographic Quadrangle Map. This is the primary scale of data produced, and depicts greater detail for a smaller area than intermediate-scale (1:50,000 and 1:100,000) and small-scale (1:250,000, 1:2,000,000 or smaller) products, which show selectively less detail for larger areas.

U.S. Geological Survey
508 National Center
12201 Sunrise Valley Drive
Reston, VA 20192
www.mapping.usgs.gov/

To order USGS maps by fax, select, print, and complete one of the online forms and fax to 303-202-4693. A list of commercial dealers also is available at www.mapping.usgs.gov/esic/usimage/dealers.html/. For more information or ordering assistance, call 1-800-HELP-MAP, or write:

USGS Information Services
Box 25286
Denver, CO 80225

For additional information, contact any USGS Earth Science Information Center or call 1-800-USA-MAPS.

Qs and As
OFFSITE CONSEQUENCE ANALYSIS

Q. How close must a stationary source be to a weather station for that station's data to be applicable to the stationary source?

A. EPA has not set specific distance limits, but will allow owners and operators to use reasonable judgement in determining whether data from a weather station is applicable to the stationary source. Factors such as topography and distance between the stationary source and a weather station should be taken into consideration when evaluating the applicability of the weather station's data to the stationary source.

Q. Must air dispersion models that are used to analyze worst-case release scenarios be able to account for multiple vessels and how those vessels could impact one another in the event of an accidental release?

A. No. Models used for worst-case release scenario analysis do not need to consider compounding effects of accidental releases from multiple vessels because worst-case release is defined by the rule as a single vessel or process line failure that will result in the greatest distance to an endpoint.

Q. If the estimated population changes, would the RMP have to be updated?

A. No. Changes in U.S. Census data do not necessitate the revision of the RMP. However, all updates to the RMP should use the most recent U.S. Census data.

Q. What if a flammable event has a different time duration than the 5 kw/m^2 for 40 seconds?

A. EPA recognizes that flammable events may occur for a different amount of exposure time. Therefore, the owner or operator should determine the distance to an equivalent exposure - e.g. if the flammable event occurs for 20 seconds, what is the distance to an equivalent exposure (XX kw/m^2)?

Q. Could positive buoyancy models be used?

A. Yes, provided there is a basis for use and the owner or operator explains the rationale for use of positive buoyancy models.

EXAMPLES OF WORST CASE

EXAMPLE ▸ SOURCE A

Source A, a ceramics manufacturer, has only one process on site containing a regulated substance above its threshold quantity: a storage tank containing more than 10,000 pounds of the flammable substance propane. A worst-case analysis is carried out for the propane tank, assuming release to air of the total contents of the tank resulting in a vapor cloud explosion. The distance to the 1 psi overpressure is estimated to be 0.17 miles. The tank is 300 yards inside the fenceline; the nearest public receptor is 100 yards from the fenceline, or 400 yards (0.23 miles) from the tank. The distance to the nearest public receptor is greater than the distance to the endpoint; therefore, Source A's only regulated process is eligible for Program 1. Source A must report the worst-case analysis to demonstrate eligibility for Program 1.

EXAMPLE ▸ SOURCE B

Source B, a small propane retailer, has one covered process on site, an 18,000-gallon propane tank. This tank holds a maximum of 65,000 pounds of propane. Source B must carry out a worst-case analysis for this process. The distance to a 1 psi overpressure for a vapor cloud explosion of 65,000 pounds of propane is estimated to be 0.32 miles. The retailer is located in a commercial area, and several small businesses border the facility and are within the distance to the endpoint; therefore, Source B's process is not eligible for Program 1. Source B must report the worst-case analysis in the RMP.

EXAMPLE ▸ SOURCE C

Source C, a retail operation that supplies ammonia and propane, has two covered processes: a 200-ton ammonia storage tank and an 18,000-gallon propane storage tank containing a maximum quantity of about 65,000 pounds. Source C carries out worst-case consequence analyses for both of these processes, with the following results:

- ✦ For 400,000 pounds of anhydrous ammonia, the distance to the specified endpoint (0.14 mg/L) is estimated as more than 10 miles; and
- ✦ For a vapor cloud explosion of 65,000 pounds of propane, the distance to an endpoint is estimated as 0.32 miles.

Residences and a business center are located within 0.15 miles of the facility; therefore, neither regulated process is eligible for Program 1. Source C must report the results of both worst-case analyses (one for toxic substances and one for flammable substances) in the RMP.

EXAMPLE ▸ SOURCE D

Source D is a medium-sized metal products manufacturer with two processes containing regulated toxic substances above their thresholds: a tank storing 50,000 pounds of 37 percent hydrochloric acid for use in plating processes and five interconnected, one-ton tanks of chlorine used in a wastewater treatment plant. Only one worst-case analysis is required for toxic substances for Program 2 and Program 3 processes; because of the greater toxicity and volatility of chlorine, Source D expects that a worst-case release of chlorine would result in the greatest distance to the endpoint. Source D does not believe the hydrochloric acid process would be eligible for Program 1 because of the proximity of public receptors (including workers at an adjacent industrial facility), and, therefore, only carries out the worst-case analysis for the chlorine process. A distance of 2.80 miles to the endpoint is estimated for a release of 2,000 pounds of chlorine gas. Source D must report this worst-case analysis in the RMP.

EXAMPLE ▸ SOURCE E

Source E is an inorganic chemical manufacturer with two covered processes: a tank containing 10 tons of 70 percent hydrofluoric acid solution and ten one-ton tanks of chlorine on a rack for wastewater treatment. Source E must carry out one worst-case analysis for regulated toxic substances for Program 2 and Program 3 processes. Because the toxic endpoint of chlorine is lower than that of hydrofluoric acid, and because the release rate will probably be greater for a gas than a solution, Source E decides to carry out the analysis for chlorine as the required worst-case analysis for toxic substances. Source E believes the hydrofluoric acid process may be eligible for Program 1 and, therefore, decides to do a worst-case analysis for this process as well. Results of the worst-case analyses for these two processes are:

- 2.80 miles for 2,000 pounds of chlorine
- 1 mile for 20,000 pounds of 70 percent hydrofluoric acid (released in a diked area)

Homes and businesses are located less than a mile from either process; therefore, the hydrofluoric acid process is not eligible for Program 1. Source E must report the results of the analysis for chlorine in the RMP.

EXAMPLE ‣ SOURCE F

Source F is a large chemical manufacturer with 11 regulated substances above their threshold quantities, including three flammable substances and eight toxic substances. The processes containing flammable substances are: three 18,000-gallon tanks containing 26,000 pounds of ethylene, 66,000 pounds of propylene, and 65,000 pounds of propane. The largest quantities of toxic substances in processes are: 25,000 pounds of toluene diisocyanate (TDI), 100,000 pounds of chloroform, 25,000 pounds of anhydrous hydrogen chloride, 20,000 pounds of chlorine, 80,000 pounds of epichlorohydrin, 100,000 pounds of methyl chloride, 10,000 pounds of hydrogen cyanide, and 1,000 pounds of phosgene. For the RMP, Source F has to report one worst-case analysis for flammable substances and one for toxic substances; however, Source F believes the processes containing flammable substances may be eligible for Program 1 and, therefore, chooses to carry out a worst-case analysis for each of these processes. In addition, Source F believes the processes containing TDI and chloroform may be eligible for Process 1, because of the low volatility of TDI and the relatively low toxicity of chloroform, and decides to carry out analyses to determine eligibility. Source F is not sure which of the other processes containing toxic substances will give the greatest distance to the endpoint; therefore, it conducts screening analyses for all these processes. The worst-case distances for vapor cloud explosions of the flammable substances are:

- 0.24 miles for 26,000 pounds of ethylene;
- 0.32 miles for 66,000 pounds of propylene; and
- 0.32 miles for 65,000 pounds of propane.

The worst-case distances to the endpoints for the toxic substances are:

- 0.06 miles for 25,000 pounds of TDI;
- 0.49 miles for 100,000 pounds of chloroform;
- 4.8 miles for 25,000 pounds of hydrogen chloride;
- 10 miles for 20,000 pounds of chlorine;
- 2.2 miles for 80,000 pounds of epichlorohydrin;
- 2.0 miles for 100,000 pounds of methyl chloride;
- 5.2 miles for 10,000 pounds of hydrogen cyanide; and
- 11 miles for 1,000 pounds of phosgene.

The processes containing ethylene and propylene are located 500 yards (0.28 miles) from a river (0.5 miles wide). The distance to the endpoint for these two processes does not extend beyond the river, which is not a recreational area; the processes are eligible for Program 1 (having met the other criteria). The propane tank is located 200 yards (0.11 miles) from another facility; the distance to the endpoint reaches this other facility; the propane process is not eligible for Program 1. The distances to the endpoints for the TDI process is exceeded by the distance to public receptors in any direction; therefore, this process is also eligible for Program 1.

Source F reports the worst-case analysis results for ethylene, propylene, and TDI to demonstrate eligibility for Program 1. It reports the results for propane as the required worst-case analysis for flammable substances and the results for phosgene as the required worst-case analysis for toxic substances.

EXAMPLES OF ALTERNATIVE RELEASES

EXAMPLE ▸ SOURCE A

Source A's only covered process (a tank containing 10,000 pounds of the flammable substance, propane) is in Program 1, because the worst-case analysis showed no public receptors within the distance to the endpoint. Therefore, Source A does not have to carry out an alternative scenario analysis.

EXAMPLE ▸ SOURCE B

Source B, a small propane retailer, has one covered process on site, an 18,000-gallon tank with a maximum of 65,000 pounds of propane. The worst-case analysis showed public receptors within the distance to the endpoint; the propane process is thus not eligible for Program 1, and instead is in Program 2. Source B must carry out an alternative scenario analysis for this process. Source B can choose any reasonable scenario for this analysis, considering site characteristics. Source B must be able to explain its choice, should questions arise.

EXAMPLE ▸ SOURCE C

Source C, a retail operation that supplies ammonia and propane, has two covered processes: an 18,000-gallon propane storage tank containing 65,000 pounds of propane (a regulated flammable substance) and an ammonia storage tank containing 400,000 pounds of anhydrous ammonia (a regulated toxic substance). The worst-case consequence analyses for these processes indicated neither is eligible for Program 1. Source C must carry out and report an alternative scenario analysis for each of these processes. Any reasonable and defensible scenarios can be analyzed for these processes.

EXAMPLE ▸ SOURCE D

Source D is a medium-sized metal products manufacturer with two covered processes containing regulated toxic substances: a chlorine wastewater treatment plant with 10,000 pounds of chlorine and a tank containing 50,000 pounds of 37 percent hydrochloric acid. Because of the proximity of public receptors, neither of these processes is eligible for Program 1. Source D must carry out and report an alternative scenario analysis for each of these processes. Source D may analyze any scenarios that are reasonable for the site and processes; the source must be able to explain its choice of scenarios.

EXAMPLE ▸ SOURCE E

Source E is an inorganic chemical manufacturer with two covered processes, one containing 20,000 pounds of chlorine and the other containing 20,000 pounds of 70 percent hydrofluoric acid. Source E's worst-case analyses indicated that these processes are not eligible for Program 1. Source E must carry out and report an alternative scenario analysis for each of these processes. The scenarios may be developed based on any reasonable and defensible assumptions.

EXAMPLE ▸ SOURCE F

Source F is a large chemical manufacturer with covered processes containing three regulated flammable substances and eight regulated substances. The worst-case analyses showed that the processes containing the flammable substances ethylene and propylene are eligible for Program 1, but a tank containing propane is not eligible. For flammable substances, Source F must carry out and report one alternative scenario analysis, to represent all regulated flammable substsances, for the tank with 65,000 pounds propane based on any reasonable assumptions.

The worst-case analyses showed that the process containing 25,000 pounds of the toxic substance toluene diisocyanate (TDI) also is eligible for Program 1; therefore, Source F does not need to carry out an alternative scenario analysis for TDI. Source F must carry out and report an alternative scenario analysis for each regulated toxic substance in a covered non-Program 1 process; thus, scenarios must be developed and analyzed for hydrogen chloride, chlorine, epichlorohydrin, methyl chloride, hydrogen cyanide, chloroform, and phosgene. If the substances are found in more than one vessel, the analysis should be conducted with respect to the vessel that presents the greatest relative risk of a release. Analyses of each vessel are not needed. Source F can develop any reasonable scenarios for these substances.